REMARKS/ARGUMENTS

The amendment to specification page 7 inserts generic language for the Laponite® clays. This amendment is supported by the attached information for Laponite® materials. This generic language has been entered into Claim 4.

New Claim 15 is supported at specification page 3, lines 13-16. New Claim 16 is supported at page 3, lines 17-28. New Claims 17-19 are supported at specification page 5, lines 1-2, and 17 and by specification page 6, line 6. New Claims 20-22 are supported by specification page 3, lines 29-32. New Claims 23 and 24 are supported by Claim 1, Claims 17-19, specification page 6, lines 25-27, and page 8, lines 1-5 and 16-20. Finally, New Claims 25 and 26 are supported by Claims 13 and 14 and by specification page 13, lines 7-16. No new matter has been entered.

The rejection over <u>Elspass</u> in view of <u>Meschke</u> is traversed.

<u>Elspass</u>, the primary reference, does not form a composite material by drying a dispersion. Instead, in <u>Elspass</u> the described nanocomposite of the layered silicate material and the polymer are first recovered by coagulating the latex, which is *then* dried to form the solid nanocomposite. See column 5, lines 18-20 of the reference. <u>Elspass</u> exemplifies this composite formation in Example 3 appearing at column 6, lines 38ff, of the reference where the latex is coagulated by the addition of excess methanol. Importantly, a coagulated latex is not a dispersion. Only after coagulation (and separation of the solid from the liquid) is the material dried.

In addition to the fact that <u>Elspass</u> does not dry a dispersion, another distinction between the reference disclosure and the present invention is the fact, recognized by the Examiner, that drying by atomization is nowhere disclosed or suggested. <u>Meschke</u>, however, fails to make up for that lacking in <u>Elspass</u> as <u>Meschke</u> similarly fails to disclose or suggest the drying of a dispersion containing a lamellar compound by atomization. While clay is

disclosed in Meschke, none of the spray-dried powders disclosed therein contain this material. Instead, the slurries that are spray-dried contain alumina: see, e.g., column 25, lines 8 ff noting, in addition, that the powders produced cannot be considered to be composite materials in view of the exceedingly low amounts of polymer present simply as a binder.
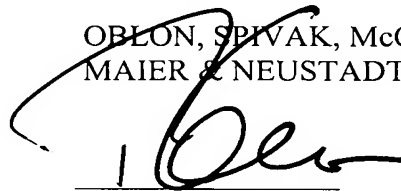
In addition to this distinction, the different physical forms of the compositions dried in the two references further argue against their combination, Elspass disclosing a latex in dispersed or coagulated form whereas Meschke discloses slurries. In view of these different physical forms, and the different components therein, one of ordinary skill in the art would not be motivated to ignore Elspass' specific teaching that his latex be coagulated before drying.

Thus, and when viewed in the appropriate context, even the combination of references cited against the claims herein does not disclose or suggest what Applicants are claiming. Parker, cited against Claim 7, does not alter this conclusion as Parker is insufficient, even in combination with Meschke, to lead one of ordinary skill in the art to abandon Elspass' method of coagulation followed by drying.

Accordingly, and in view of the above amendments and explanatory remarks, Applicants respectfully request the reconsideration and withdrawal of the outstanding rejections. The combination of prior art applied herein does not teach, suggest or disclose Applicants presently claimed invention, and for these reasons the presently pending claims should be passed to Issue.

Respectfully submitted,

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9

Laponite technical information

Laponite- synthetic layered silicate– its chemistry, structure and relationship to natural clays

Laponite products are a range of synthetic layered silicates. An extensive range of formulation guides and application bulletins has been produced by **Rockwood**. These demonstrate the novel properties of this versatile material.

For more information,
consult The Laponite Technical Directory
available from **Rockwood** or your local distributor

1. INTRODUCTION

Laponite is an entirely synthetic smectite clay which closely resembles the natural clay mineral hectorite in both structure and composition. It is layered hydrous magnesium silicate which is hydrothermally synthesized from simple silicates, and lithium and magnesium salts in the presence of mineralizing agents. It is then filtered, washed, dried and milled.

Refined natural hectorites and bentonites find wide industrial application as shear sensitive anti-settling agents in water based formulations. Laponite has a number of distinct advantages over natural "swelling" clays in rheological applications. It disperses much more readily to give colourless, transparent, and highly thixotropic gels. Laponite is free from crystalline silica impurities which are found in natural clays and is chemically pure and consistent in its properties as it is synthesized under controlled conditions. Between three and fives times less Laponite by weight is required to achieve the same degree of thickening as refined natural clays, making the use of Laponite highly cost effective in many applications.

2. THE STRUCTURE OF CLAY MINERALS (Ref 1,2)

In general clay mineral particles are less than two microns in size when fully dispersed.

Most clay minerals are part of a large family of silicate minerals called phyllosilicates. These layered structures are built up from two dimensional sheets of tetrahedrally co-ordinated silica linked to parallel sheets of octahedrally co-ordinated alumina or magnesium oxide,

In (1:1) phyllosilicates such as kaolin (china clay) each tetrahedral layer is linked to one octahedral layer.

In (2:1) phyllosilicates such as montmorillonites (bentonites) and Laponite each octahedral layer is sandwiched between two tetrahedral layers.

Although not strictly phyllosilicates and palygorskite clay minerals such as attapulgite and sepiolite have similar structures but based on silica sheets in which ribbons of free oxygen linkages point in alternate directions (not in the same direction as in phyllosilicates). Adjacent sheets are linked by small blocks of octahedral cations, not extensive 2D sheets of octahedral cations. The palygorskite minerals have fibrous habits rather than the platelike habits of the phyllosilicate clay minerals.

If either the (1:1) or the (2:1) layer structure is not electrostatically neutral then the structure is said to have a layer charge. This excess charge is neutralized by various interlayer materials such as cations, hydrated cations, or octahedral hydroxide species or sheets.

Chlorite is a mixed layer clay mineral whose basic unit consists of a (2:1) layer plus a hydroxide sheet between the layers (in place of the interlayer cations of phyllosilicates).

The discussion that follows concentrates on the (2:1) layer structures of Laponite and the related minerals hectorite and montmorillonite. A summary classification of clay minerals is given in Appendix 1, and a compendium of British, European, and US clay nomenclature given in Appendix 2.

3.   THE STRUCTURE OF LAPONITE AND RELATED (2:1) CLAY MINERALS

The basic structure of mica was established in c.1930 by x-ray crystallography and the structures of the related but poorly crystalline clay minerals have been derived by analogy.

(2:1) layer phyllosilicates have composite sheets in which a layer of octahedrally co-ordinated cations is sandwiched between two identical layers of linked $(Si/Al\ O_4)$ tetrahedra. These tetrahedral layers (composition T_2O_5, where T = Si or Al) are linked to form 2-D arrays of interlocking "6" rings (see Figure 1). The fourth (apical) oxygen of each tetrahedron is at right angles to the plane, and are all inclined inwards, forming part of the octahedral co-ordination sphere of the central cations. The tetrahedral sheets are displaced by one third of the crystallographic dimension a) (in the 100 direction) with respect to each other, so as to give the octahedral co-ordination to the central cations. This is achieved using two apical oxygens from each tetrahedral layer, and the remaining two co-ordinations are with hydroxyl (or fluoride) ions at the centres of the "6" rings.

The composite sheets have a net negative charge which is balanced by K^+, Na^+, or Ca^{2+} ions in 12 fold co-ordination between two "6" rings formed by the basal oxygens of two adjacent composite sheets. The repeat distance perpendicular to the sheets is 10 A° (or a multiple of 10 A°) with unit cell dimensions a) 5.3 A° and b) 9.2 A° within the sheets. Since Laponite is synthesized in a sodium ion rich environment the great majority of its interlayer cations are sodium.

Phyllosilicates may be divided into two major classes : dioctahedral and trioctaedral. In dioctahedral minerals two thirds of the octahedral sites occupied (ideally by Al^{3+} ions), and in trioctahedral phyllosilicates all of the octahedral sites are filled (ideally by Mg^2 ions). Idealized dioctahedral and trioctahedral phyllosilicate structures are represented schematically in Figures 2 and 3. If there is no net charge on the sheets there are no charge balancing cations. This is the case for the non swelling soft clay minerals pyrophyllite (dioctahedral) and talc (trioctahedral).

In the smectite group (including Laponite, hectorite, and bentonites) there are some substitutions in both octahedral and tetrahedral layers, resulting in a small number of interlayer cations. The whole group are "swelling" clays which take up water and organic liquids between the composite layers and have marked cation exchange capacities.

Vermiculites have greater charge imbalances on the composite sheets and hence greater numbers of interlayer cations - and generally larger crystalline sizes. More energy is required to separate the sheets on hydration and therefore, vermiculites swell to lesser extents than smectites.

In the micas even higher degrees of substitution lead to essentially all interlayer cation sites being occupied (by monovalent ions for micas and by divalent ions for brittle micas). These minerals are anhydrous non-swelling, well crystallized rock forming minerals, not clay minerals.

4. THE CHEMISTRY OF LAPONITE AND SMECTITE CLAYS (Ref 3)

In dioctahedral smectites (the montmorillonite sub-group) substitution of Al^{3+} by Mg^{2+} or Fe^{2+} in the octahedral layer or in some cases of Si^{4+} by Al^{3+} in the tetrahedral layer is balances by the presence of Na^+, K^+, Ca^{2+} or Mg^{2+} cations between the layers. European montmorillonites have calcium as the predominant interlayer cation. American (Wyoming) montmorillonites have sodium as the predominant interlayer cation and are often referred to as bentonites. Iron rich montmorillonites are referred to as nontronite and aluminium rich montmorillonites (usually with some tetrahedral substitution of aluminium ions for silicon) are termed beidellite.

In tri-octahedral smectites (the Saponite sub-group) substitution of Mg^{2+} by Li^+ in the octahedral layer or of Si^{4+} by Al^{3+} in the tetrahedral layers is balanced by interlayer cations. Natural hectorites have appreciable lithium contents but little tetrahedral substitution. They have substantial levels of substitution of fluoride ions for hydroxyl ions in the co-ordination spheres of the octahedral cations. The original Laponite grades (the gelling grade Laponite B and the related delayed gelling "sol" grade Laponite S) have very similar compositions to natural hectorite.

The rapidly dispersing Laponite grades Laponite RD and the high purity Laponite XLG (with the related sol grades) and the dentifrice grade Laponite D (optimized for performance in aqueous polyol solutions) have slightly lower levels of lithium substitution and have no fluoride substitution for hydroxide in the composite sheets. All Laponite grades have virtually zero aluminium levels and very low transition metal contents compared with natural clays, and are free from crystalline quartz impurities. Laponite B contains a low level of a by-product from the synthesis $Na\ Mg\ F_3$, which is similar to the natural mineral neighborite.

Saponites have significant levels of substitution by aluminium in the tetrahedral layers and some substitution of octahedral sites with trivalent ions (mainly iron). Sauconites have significant degrees of aluminium substitution in the tetrahedral layers and significant levels of zinc and aluminium substitution in the octahedral layers.

Idealized unit cell compositions for Laponite and related clay minerals are given in Table 1.

Smectite clays swell as further water (or polar organic liquids) enter the interlayer regions. This is due to hydration (solvation) or the interlayer cations and the platelet surfaces. For calcium or magnesium smectites the basal spacing of 9.5A° for the fully dried materials increases to 14.5 - 15.5 A° for low moisture powders and to 19A° for pastes in water. The individual clay platelets do not separate completely on dispersion in water, due to the strong attractive forces between the platelets, and hence calcium and magnesium smectites are not "thickening" clays. If fully dried the lithium and sodium forms of natural clays and the synthetic sodium forms of Laponite have basal spacings of 9.5A°. On addition of water the basal spacing increases to 12.5A° for low moisture powders (as commercially supplied) and up to 19.0A° for pastes. As the amount of water is increased the basal spacings increase further until eventually in dilute suspensions the negatively charged clay platelets separate completely and become dispersed as colloidal sized particles. The mechanism for the formation of colloidal dispersions of Laponite and "thickening" clays and the factors which stabilize or destabilize them are discussed in the next section. Figure 4 shows a schematic representation of the size and morphology of the individual clay platelets when fully dispersed at dilute concentration in water (the "primary particles") for Laponite RD, Laponite B, and typical natural thickening clays. The primary particles of all these smectite clays are approximately 10A° thick but the natural clays are an order of magnitude bigger in both width and breadth.

Laponite RD forms colourless completely transparent dispersions in water because of its high purity and because the primary particles are small in size (250A° in diameter) compared with the wavelength of visible light (4000-7000A°). The primary particles of Laponite RD are shown schematically in Figure 5. Laponite B has slightly larger primary particles (300-400A° in diameter) and gives slightly hazy dispersions in water due to the low levels of $NaMgF_3$ impurity. Natural clays, however, because of mineral and transition metal impurities, and their much larger primary particles, give entirely opaque pink to brown dispersions in water. The high clarity and lack if inherent colour of Laponite, together with its high purity, are used to advantage in many industrial applications.

## 5.   THE DISPERSION OF LAPONITE AND NATURAL THICKENING CLAYS

A simplified description of the factors which stabilize dilute dispersions of colloidal clay minerals in polar liquids is given below. Readers are referred to the treatises of Verwey and Overbeek (Ref 4) for the development of the conventional theory for the stabilization of charged colloidal particles, and to Van Olphen (Ref 5) for the application of this theory to clay minerals. This DVLO theory (named after the originators Derjaguin, Landau, Verwey and Overbeek) takes into account only electrostatic repulsion between the charted particles and Van-der-Waals' attractive forces.

Recently Van Oss et al (Ref 6) have stressed that polar electron-donor/electron-acceptor forces (including hydrogen bonding) are also important, particularly for short range interactions (10-50A°). These polar forces may be attractive or repulsive but since they do not alter the qualitative description of the stabilization of colloidal clay dispersions they will not be discussed further in this bulletin.

As described above smectite clays have a structural negative charge due to substitution of cations in the composite layers. This negative charge is independent of the level and type of electrolyte in which the clay is dispersed. However, the electrolyte level and type has a marked effect on the stability of dispersed clay particles as shown below. The charge balancing positive cations hold the negatively charged composite sheets closely together as aggregates of orientated platelets in "dry" Laponite or other smectite clays. If the clay platelets are fully dispersed in dilute aqueous suspension ("hydrated") then the charge balancing cations are distributed in a diffuse region either side of the clay composite layers (with a higher concentration close to the clay surface than at greater distances). The interaction between these "Gouy-Chapman diffuse electrical double layers" (electrical double layers) formed by the structural negative charges of the clay platelets and the diffuse cloud of positive charge balancing cations causes repulsion between clay platelets which approach each other. Van der Waal's attractive forces oppose these repulsive forces and if more powerful will cause the dispersed platelets to reorder as orientated stacks held together by the charge balancing cations. The clay will then precipitate out of suspension partially or completely. This process is called "flocculation".

The net effects of repulsion between the electrical double layers and the Van der Waal's attractive terms (and also the polar forces) determine whether a given Laponite or clay sample will fully disperse in the aqueous medium chosen, or if having been dispersed will remain stable, or flocculate. Factors which reduce the thickness of the electrical double layer will reduce the repulsion between adjacent clay platelets and hence increase the likelihood of flocculation.

4

Factors which affect the thickness of the double layers include the level and type of electrolyte, the size of the clay platelets, and the dielectric constant of the medium. The presence of excess electrolyte in the bulk water phase causes the double layer to shrink in size. The influence of the valency of the electrolyte is very strong; the relative concentration to bring about flocculation by trivalent cations (eg: Fe^{3+}, Al^{3+}) is much less than that by divalent cations (eg: Mg^{2+}, Ca^{2+}), which in turn is much less than that by monovalent cations (eg: Na^+, Li^+). Even the monovalent alkali metal cations form a series where the concentration required to induce flocculation increases in the order...

$$Cs^+ < Rb^+ < K^+ < Na^+ < Li^+$$
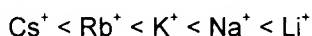
... as the degree of hydration of the ions increases. The flocculating effects of polyvalent ions are enhanced as they preferentially exchange for sodium ions in the layers close to the clay platelets thus transforming thickening clays to non thickening forms.

The addition of miscible organic liquids reduces the dielectric constant of the aqueous phase and reduces the thickness of the electrical double layers surrounding the clay platelets. The concentration of polar organic liquids required to cause flocculation increased with the dielectric constant of the organic molecule and hence with its polarity (ie. in general less acetone than glycerol is required to flocculate clays).

The repulsion between individual platelets is reduced the smaller the size of the platelets, explaining why Laponite has lower total electrolyte tolerance than natural thickening clays with larger primary particles. However, the energy barrier which must be overcome to enable initial separation of the clay platelets ("delamination") on hydration is also less the smaller the size of the clay platelets. This means that sodium Laponite readily delaminates in water at room temperature (although is disperses more rapidly at high temperature) whereas the sodium forms of natural clays may need the input of mechanical energy (high shear mixing) or thermal energy (heating) to enable them to fully disperse. Polyvalent cationic forms of Laponite or natural clays will not delaminate on hydration as, even after swelling, the attractive forces between the platelets exceed the repulsive forces between the diminished double layers of the multivalent cation forms (at all particle separations).

Natural thickening clays are often treated with large excesses of sodium carbonate, not only to reduce their calcium and magnesium interlayer contents but also to remove interlayer protonic sites and neutralize any natural organic acids present.

6.   GEL FORMATION

Dilute suspensions of Laponite or clays in water with low electrolyte levels will remain as low viscosity "sols" of non interacting individual platelets for long time periods. However, the most important feature of the clay's rheology is their ability to form highly thixotropic gels. Laponite and montmorillonites will form gels in demineralized water, but gelation is more efficient in the presence of electrolyte levels below those required to flocculate the clays out of suspension.

Ramsay and Avery (Ref 7 and 8) have studied the gelation of Laponite RD in demineralized water, and confirmed the small effective size of the primary particles by a number of sophisticated techniques. Their results indicate that there is little interaction between the

dispersed individual platelets at low concentrations (<1%), but that translational motion is restricted at higher concentrations. At 3% concentration and above the whole solution gels as face to face interactions between the electrical double layers of individual platelets make them virtually immobile.

This gives rise to an equilibrium structure with an elastic response to applied shear stresses until a critical yield stress is exceeded. Above the critical yield stress extensive disruption to the dispersion occurs and the dispersion flows under applied stresses (that is it shows a viscous response).

A similar mechanism for the gelation of montmorillonites at low electrolyte levels has been proposed by Ottwill et all (Ref 9). On addition of electrolyte the thickness of the electrical double layers is reduced. However ...

1. less Laponite (1-1½%) or clay is required to form a gel;

2. the gel strength is increased for a given clay concentration,
    but not the critical yield stress;

and 3. the effects of different electrolytes are equivalent to those
    for the flocculation series discussed above (ie less multivalent
    electrolyte is needed to achieve optimum gel strength than
    monovalent electrolyte, etc.).

It appears that gel formation in electrolyte containing solutions occurs by a different mechanism than that in demineralized water, and that partial flocculation of the Laponite or clay is involved.

This is generally proposed to be the result of face-to-edge (and edge-to-edge) interactions between the clay platelets. The mechanism for this interaction involves the platelet edges having small localised positive charged (generated by the adsorption of ions at sites where the tetrahedral and octahedral sheets terminate). This is illustrated schematically for the Laponite RD primary particles in Figure 5. This adsorption is dependent on the species and concentration of ions in solution and on the pH of the medium.

As electrolyte is added to a dispersion in demineralized water the gel strength may at first be reduced (dependent on the nature of the cation) as the thickness of the double layers is reduced and the efficiency of face to face interactions is decreased. But in any case on further increase in electrolyte level, the gel strength increases as interactions between the positive double layers at the edges of platelets and the negatively charged double layers associated with the faces become predominant and the classic clay "house of cards" gel structure forms. An idealized 2-D representation of this is shown in Figure 6. The gel consists of a single "floc" of primary particles held together by weak electrostatic forces.

A number of features of the rheology of Laponite and clays support this type of mechanism for gel formation.

1. Solid particles are held within the 3D gel structure, not stabilized
    by viscosity alone. Laponite shows excellent suspension
    properties for materials of all densities.

6

2. The gel structure is readily broken down on application of shear stresses. Laponite shows a very high degree of shear thinning.

3. When under shear there is little resistance to flow. Laponite has low viscosity under shear.

4. The gel structure takes time to reform, and hence the gel strength rebuilds progressively when the shear stress is removed. The rate of restructuring is faster at higher temperatures. Laponite restructures far more rapidly than natural thickening clays.

On further addition of electrolyte the double layers are further reduced in thickness and individual platelets begin to flocculate back together face-to-face. This reduces the number of particles available to form the extended "house of cards" gel structure and results in the gel strength progressively diminishing on addition of electrolyte past the "optimum" level. The high clarity of the Laponite gels is progressively lost in this region as the size of the flocculated particles increases. The effects of added electrolyte on gel strength are illustrated schematically in Figure 7, and experimental curves for Laponite RD with a range of different electrolytes shown in Figure 8.

Although a concentration of 3% of Laponite RD is needed to form a gel in demineralized water, at the optimum electrolyte levels Laponite RD will form weak gels at about 1½% concentration, invertible gels at 2% concentration, and gels which can be cut into slices with a knife at 4% concentration.

The relative thickening efficiencies of Laponite RD, and highly refined commercial samples of natural hectorite and bentonite are compared in Figure 9. Not only does Laponite give high clarity and colourless gels, but between 3 and 5 times less by weight is required to achieve the same degree of thickening. This is thought to be due to the very high degree of delamination of the Laponite.

This makes the use of Laponite cost effective versus high quality refined natural clays in many industrial applications. Dependent on the concentration of the Laponite, and also on its interactions with other compounds present, the rheological properties of the system may be varied from a barely perceptible degree of "structure" to a firm ringing gel. Typical usage levels are from 0.1-0.3% in high solids formulations (such as toothpaste or paints) and up to 0.8-2.0% in low solids formulations (such as gelled caustic cleansers).

The key advantages of Laponite over natural clays are ..

i) Laponite is free from crystalline quartz and cristobalite impurities;

ii) It has high chemical purity and consistency;

iii) It rapidly disperses without heat or high shear;

iv) It gives gels with high clarity and imparts no colour to dispersions;

7

v)	It has a low transition metal content and does not run down hypochlorite or stain coatings;

AND IN ADDITION LAPONITE HAS SEVERAL UNIQUE PROPERTIES

vi)	Laponite forms electrically conductive and coherent transparent films;

vii)	It acts as an effective soil dispersant.

Further details of Laponite and its uses are given in a range of papers and application bulletins available from Rockwood Additives Limited and our agents worldwide.

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      4.   Verwey EJW, Overbeek J Th G: "The Theory of the Stability of
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          Hectorite Dispersions: II Light Scattering and Small Angle
          Neutron Scattering": J Colloid Interface Science: 109(2), 448
          1986.

      9.   Callaghan IC, Ottewill RH: Faraday Disc: 57, 110 1974.

9

Layer type	Groups (x=charge per unit formula)	Sub Group	Species
1:1	Sepentine-Kaolin (x~0)	Sepentine (Tricot)	Chrysotile Antigorite
		Kaolin (Dioct)	Kaolin Dickite Nacrite
2:1	Talc-Pyrophyllite (x~0)	Talc (Trioct)	Talc Willemseite
		Pyrophyllite (Dioct)	Pyrophyllite
	Smectite (x~0 0.4-1.2)	Saponite (Trioct)	Saponite Sauconite Hectorite
		Montmorillonite (Dioct)	Montmorillonite Beidellite Nontronite
	Vermiculite (x~0 1.2-1.8)	Trioctahedral Vermiculites	Trioctahedral Vermiculite
		Dioctahedral Vermiculites	Dioctahedral Vermiculite
	Mica (x~2.0)	Trioctahedral Mica	Phlogopite Biotite Lepidolite
		Dioctahedral Mica	Muscovite Paragonite
	Brittle Mica (x~4.0)	Trioctahedral	Clintonite
		Dioctahedral	Margarite
	Chlorite	Tiroctahedral Chlorites	Clinochlore
		Dioctahedral Chlorites	Donbassite
		Mixed Chlorites	Cookeite
2:1 Inverted ribbons	Sepiolite-Palygorskite (x variable)	Sepiolites	Sepiolite Loughlinite
		Palygorskites	Palygorskite

Only some examples given in each Sub-Group

10

CLAY MINERAL NOMENCLATURE

There is some confusion about generalized clay names used in the UK. USA and Europe. The following table is an attempt to clarify this.

UK	USA	EUROPE	CORRECT DESCRIPTION
Montmorillonite	Southern Bentonite	Montmorillonite	Calcium Montmorillonite
Bentonite	Bentonite or Western Bentonite	Bentonite	Sodium Montmorillonite
Exchanged Bentonite	No equivalent	Activated Montmorillonite or Bentonite	Sodium Exchanged Montmorillonites
Activated Earth	Bleaching Earth	Bleaching Earth or Highly Activated Bleaching Earth	Acid Activated Bleaching Earth
Attapulgite	Attapulgite	Attapulgite	Palygorskite
Fullers Earth		Fullers Earth	Calcium Montmorillonite
	Fullers Earth		Palygorskite

Section 1 - Identification of the Substance and of the Company

Product Name:

Laponite® RDS, XLS and DS

Chemical Name:

Hydrous Sodium Lithium Magnesium Silicate with tetra sodium pyrophosphate

Product Uses:
Laponite® is used to control viscosity and flow properties in water based formulations such as toothpaste, paint, personal care and household cleaning products. Laponite® can impart shear sensitive viscosity and improve syneresis control. Laponite® is also used to produce antistatic coatings.

Company Identification:

Contact:

Rockwood Additives Limited
PO Box 2, Moorfield Road
Widnes. U.K.
WA8 0JU.
Tel: +44 (0) 151 495 2222

Emergency Telephone Number:

+44 (0) 151-424-5555

Section 2 - Chemical Composition/Information on Ingredients:

Chemical nature: Synthetic hectorite, (synthetic smectite clay) containing tetra sodium pyrophosphate.

Components	CAS No.	EINECS No.	Content % by wt	"R" phrase	Symbol
Hydrous Sodium Lithium Magnesium Silicate	53320-86-8	258-476-2	90 - 100	none	none
Tetra sodium pyrophosphate	7722-88-5	231-767-1	5 - 10	none	none

Section 3 - Hazards Identification:

Hazard designation: None. This product is not classified as hazardous according to EC Directive 1999/45/EC

Potential issues: None known

Skin Contact: May cause degreasing of skin, dryness or cracking	Eye Contact: Irritation due to physical contact with dust.	Inhalation: May cause irritation of nose and mouth due to dust	Ingestion: May cause gastric irritation in some individuals

CHIP/RISK/SAFETY Classification
RISK PHRASES associated with the product   None
SAFETY PHRASES associated with the product   S22   Do not breathe dust.
                                                   S51   Use only in well ventilated areas

Section 4 - First Aid Measures:

General Information: No special measures required

Skin Contact: Irrigate thoroughly with cold water. Seek medical attention if symptoms persist	Eye Contact: Irrigate thoroughly with cold water, keeping eyelids open to ensure effective washing. Seek medical advice if irritation persists.
Inhalation: Remove person to fresh air, loosen clothing and seek expert medical help	Ingestion: Small amounts: wash mouth out with water and give lots of water to drink. If large amounts ingested medical advice should be sought.

Section 5 - Fire-Fighting Measures:

Lower Explosive Limit: Not applicable.

Known or anticipated hazardous products of combustion: Not applicable

Basic fire fighting guidance: Wet Laponite may present a slip hazard.

Extinguishing media: Use extinguisher to suit cause of fire

Section 6 - Accidental Release Measures:

Wear suitable protective clothing against nuisance dust (see Section 8)
Sweep up or vacuum spilled product and dispose in accordance with Local Authority Regulations
Avoid wetting the spillage - product is slippery when wet.

Section 7 - Handling and Storage:

Handling:
Handle using appropriate PPE in well ventilated areas using methods that minimise dust generation.
Ensure adequate ventilation at point of use. Use dust mask if dust levels are above the Occupational Exposure Limit (see Section 8).

Storage:
Store under dry conditions since high humidity or direct contact with water will result in caking. Store away from mineral acids and substances liable to decomposition by dust e.g. peroxides. Seal container after use.

Specific use:
This product does not have one particular specified use. This section does not apply.

Section 8 - Exposure Controls/Personal Protection:

Hand Protection: Use PVC or rubber gloves	**Skin Protection:** Normal workwear supplemented by barrier cream.
Eye Protection: Wear chemical goggles approved for nuisance dust: EN166	**Respiratory Protection:** Use approved orinasal dust mask to EN 149 if Occupational exposure limits cannot be met by ventilation.

Occupational Exposure Limit:
This product is classed as a nuisance dust.
The OES defined for this product is for dust with an 8 hr TWA for Total inhalable dust of 10 mg/m^3 and 4 mg/m^3 for respirable dust. Dust extraction systems should operate to keep the dust levels below these limits.

Environmental Exposure Controls:
There is no reported ecotoxicity for Laponite

Section 9 - Physical and Chemical Properties:

Appearance: Free flowing white powder	**Odour:** Odourless	**pH:** 9.7 (2% dispersion in water)
Boiling Point: Not applicable	**Melting Point:** Fuses at 900°C	**Flash Point:** Not applicable
Flammability: Non-flammable	**Explosive Properties:** None	**Oxidising Properties:** Inert
Vapour Pressure: Not applicable	**Bulk Density/Specific Gravity:** 0.7-1.3 kg/dm^3 (Packed)	**Solubility:** Disperses in water to form a low viscosity colloidal suspension but does not dissolve

Section 10 – Stability and Reactivity:

Conditions to Avoid:	Materials to Avoid:	Hazardous Decomposition Products:
Avoid excessive moisture	Avoid contact with strong mineral acids or substances liable to decomposition by dust e.g.peroxide	Lithium salts if product decomposed by mineral acid.

Section 11 - Toxicology Information:

Ingestion: Low acute toxicity (LD50 - Oral rat > 8g/kg body weight)

Inhalation: LC 50 (rat) > 1.66 g/m3 (maximum supportable dust)

Eye Contact: Irritant only due to physical abrasion effects of powder. No long term irritation effects.

Skin Contact: Primary Irritation Index 0.5 (Rabbit)

Long term exposure to dust in excess of the OES may cause fibrosis of the lung tissue.

Section 12 - Ecological Information:

Not fully tested. The following information is to the best of our knowledge

Water Hazard classification = WGK 1 (self assessment), low hazard to the aquatic environment.
The product forms a colloidal suspension, the Laponite component will disperse and the polyphosphate component is soluble in water. It is the polyphosphate additive that may affect aquatic life and may cause algal blooms if released into rivers in large quantities

Degradability –The product does not degrade

Other adverse effects – none known or anticipated. Laponite contains no heavy metals or other agents, which are harmful to the environment. The material itself is ecologically inert.

Section 13 - Disposal Considerations:

Waste product may be disposed of by landfill. National and Local legislation concerning disposal of waste materials must be followed and any product disposed of using an approved waste disposal contractor.

Section 14 - Transport Information:

UN Number/Description
There are no specific transportation precautions required. This product is not classed as a dangerous substance under the classification, packaging and labelling of dangerous substances regulations.

Section 15 – Regulatory Information

Dangerous Substances Directive 67/548/EEC and Dangerous Preparations Directive 1999/45/EC:

These regulations do not apply to this product and therefore the product does not need to be labelled in accordance with EC directives or respective national laws

Information on the label: S22   Do not breathe dust.
S51   Use only in well ventilated areas

National Regulations: Control of Substances Hazardous to Health (COSHH) Regulations 1999 – these regulations apply.
CHIP 3 Regulations 2002 – this product is not on the ASL (Approved Supply List) and is not required to be labelled according to the ACLG (Approved Classification and Labelling Guide)

Other Regulations: Germany - Water Hazard classification = WKG 1 (self assessment), low hazard to the aquatic environment

California Safe Drinking Water and Toxic Enforcement Act (Proposition 65) - These do not apply

Section 16 – Other Information:

Laponite is a wholly synthetic product and therefore does not contain any quartz or respirable crystalline silica impurities.

Recommended restrictions on use: None known

Sources of key data: HSE EH40

Revision of SDS information: The data presented in this SDS is based on our current knowledge. It is believed to be accurate but is not warranted.
An asterisk (*) noted against a specific section in the SDS indicates an amendment from the previous version.